CLAIMS

What is claimed is:

1. A catalyst for use in oxidation or reduction reactions, the catalyst comprising platinum, chromium at a concentration that is no greater than 30 atomic percent, and copper, nickel, or a combination thereof at a concentration that is at least 35 atomic percent.

2. A catalyst for use in oxidation or reduction reactions, the catalyst comprising platinum, chromium, and copper, nickel, or a combination thereof, wherein the concentration of copper, nickel, or a combination thereof is at least 45 atomic percent.

3. A catalyst for use in oxidation or reduction reactions, the catalyst comprising platinum, chromium, copper and nickel.

4. A catalyst for use in oxidation or reduction reactions, the catalyst comprising platinum, chromium, and copper, wherein the concentration of chromium is no greater than 30 atomic percent.

5. A catalyst for use in oxidation or reduction reactions, the catalyst comprising platinum, chromium, and nickel, wherein the concentration of nickel is at least 35 atomic percent.

6. A catalyst for use in oxidation or reduction reactions, the catalyst comprising platinum, chromium, and nickel, wherein the concentration of platinum is less than 40 atomic percent.

7. The catalyst of one of claims 1-5 wherein platinum is at a concentration that is between about 5 and about 50 atomic percent.

8. The catalyst of claim 2, 3 or 6 wherein chromium is at a concentration that is no greater than about 55 atomic percent.

9. The catalyst of one of claims 1-6 wherein platinum is at a concentration that is between about 15 atomic percent and about 40 atomic percent, chromium is at a concentration that is between about 5 and about 25 atomic percent, and copper, nickel or a combination thereof is between about 45 and about 70 atomic percent.

10. The catalyst of one of claims 1-6 wherein platinum is at a concentration that is between about 20 and about 35 atomic percent, chromium is at a concentration that is between about 5 and about 25 atomic percent, and copper, nickel or a combination thereof is at a concentration that is between about 50 and about 65 atomic percent.

11. The catalyst of one of claims 1-6 wherein platinum is at a concentration that is between about 20 and about 30 atomic percent, chromium is at a concentration that is between about 5 and about 25 atomic percent, and copper, nickel or a combination thereof is at a concentration that is between about 50 and about 65 atomic percent.

12. A catalyst for use in oxidation or reduction reactions, the catalyst comprising platinum at a concentration that is between about 15 and about 50 atomic percent, chromium at a concentration that is between about 5 and about 45 atomic percent, and copper at a concentration that is between about 15 and about 50 atomic percent.

13. The catalyst of claim 12 wherein the platinum concentration is between about 35 and about 50 atomic percent.

14. The catalyst of claim 12 or 13 wherein the chromium concentration is between about 5 and about 35 atomic percent.

15. The catalyst of claim 12, 13 or 14 wherein the copper concentration is between about 20 and about 45 atomic percent.

16. The catalyst of one of claims 1-15 wherein the catalyst consists essentially of platinum, chromium, and copper, nickel, or a combination thereof.

17. The catalyst of one of claims 1-15 wherein the catalyst comprises an alloy of platinum, chromium, and copper and/or nickel.

18. The catalyst of one of claims 1-15 wherein the catalyst consists essentially of an alloy of platinum, chromium, and copper and/or nickel.

19. A supported electrocatalyst powder for use in electrochemical reactor devices, the supported electrocatalyst powder comprising the catalyst as in any one of claims 1-18 and electrically conductive support particles upon which the catalyst is dispersed.

20. The supported electrocatalyst powder of claim 19 wherein the electrically conductive support particles are selected from the group consisting of inorganic supports and organic supports.

21. The supported electrocatalyst powder of claim 20 wherein the electrically conductive support particles are selected from the group consisting of carbon supports and electrically conductive polymer supports.

22. A fuel cell electrode, the fuel cell electrode comprising electrocatalyst particles and an electrode substrate upon which the electrocatalyst particles are deposited, the electrocatalyst particles comprising the catalyst as in any one of claims 1-18.

23. The fuel cell electrode of claim 22 wherein the electrocatalyst particles comprise electrically conductive support particles upon which the catalyst is dispersed.

24. The fuel cell electrode of claim 23 wherein the electrically conductive support particles are selected from the group consisting of carbon supports and electrically conductive polymer supports.

25. A fuel cell comprising an anode, a cathode, a proton exchange membrane between the anode and the cathode, and the catalyst as in any one of claims 1-18 for the catalytic oxidation of a hydrogen-containing fuel or the catalytic reduction of oxygen.

26. The fuel cell of claim 25 wherein the fuel consists essentially of hydrogen.

27. The fuel cell of claim 25 wherein the fuel is a hydrocarbon-based fuel.

28. The fuel cell of claim 25 wherein the fuel comprises methanol.

29. The fuel cell of claim 25 wherein the catalyst is on the surface of the proton exchange membrane and in contact with the anode.

30. The fuel cell of claim 25 wherein the catalyst is on the surface of the anode and in contact with the proton exchange membrane.

31. The fuel cell of claim 25 wherein the catalyst is on the surface of the proton exchange membrane and in contact with the cathode.

32. The fuel cell of claim 25 wherein the catalyst is on the surface of the cathode and in contact with the proton exchange membrane.

33. A method for the electrochemical conversion of a hydrogen-containing fuel and oxygen to reaction products and electricity in a fuel cell comprising an anode, a cathode, a proton exchange membrane therebetween, the catalyst as in any one of claims 1-18, and an electrically conductive external circuit connecting the anode and cathode, the method

comprising contacting the hydrogen-containing fuel or the oxygen and the catalyst to catalytically oxidize the hydrogen-containing fuel or catalytically reduce the oxygen.

34. The method of claim 33 wherein the hydrogen-containing fuel consists essentially of hydrogen.

35. The method of claim 33 wherein the hydrogen-containing fuel is a hydrocarbon-based fuel selected from the group consisting of saturated hydrocarbons, garbage off-gas, oxygenated hydrocarbons, fossil fuels, and mixtures thereof.

36. The method of claim 33 wherein the hydrogen-containing fuel is methanol.

37. A fuel cell electrolyte membrane having an unsupported catalyst layer on a surface thereof, said unsupported catalyst layer comprising the catalyst of any one of claims 1-18.

38. A fuel cell electrode having an unsupported catalyst layer on a surface thereof, said unsupported catalyst layer comprising the catalyst of any one of claims 1-18.